

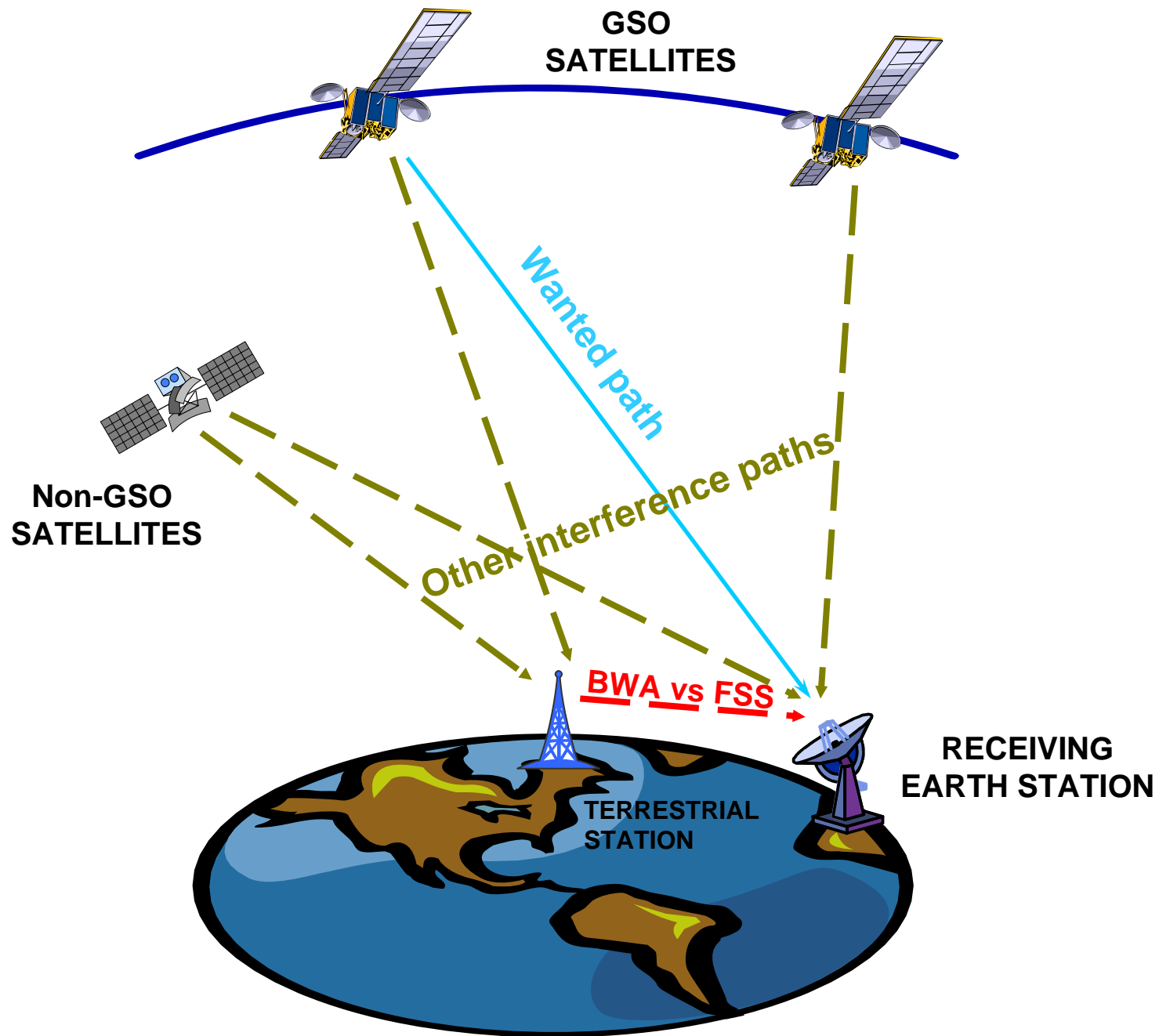


Electro-Magnetic Compatibility between BWA and FSS at 4 GHz

19th International Wroclaw
Symposium and Exhibition on
electronic compatibility

The ITU Radio Regulations

- One of their main purposes - Interference-free operation of RadioComms
- Lengthy & complex procedure
 - Established/amended by States during WRCs (every 3-4 years);
 - Opportunity to resolve interference before operation;
 - Prevents loss of investment, customers & revenue from unusable capacity due to interference.

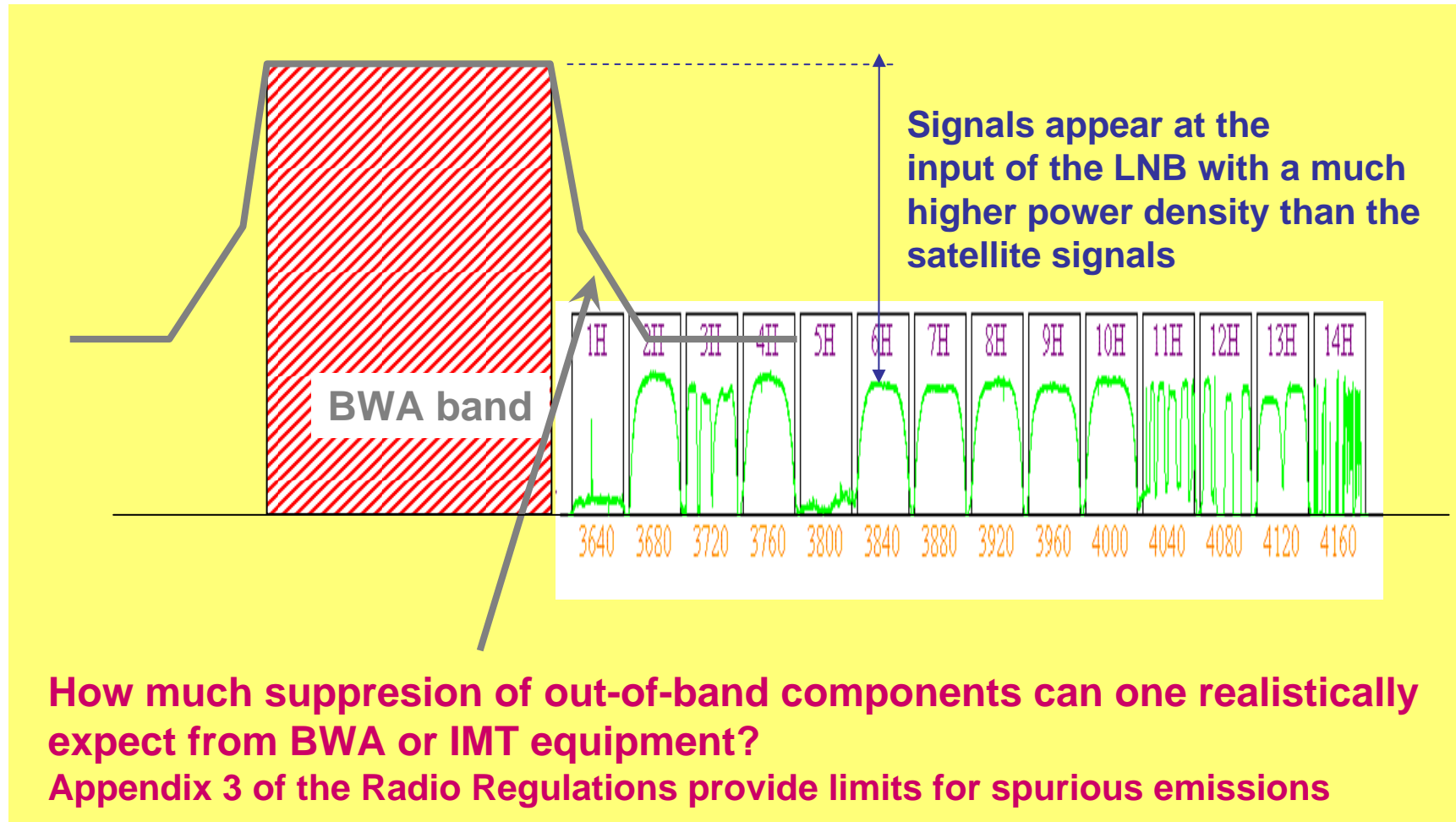


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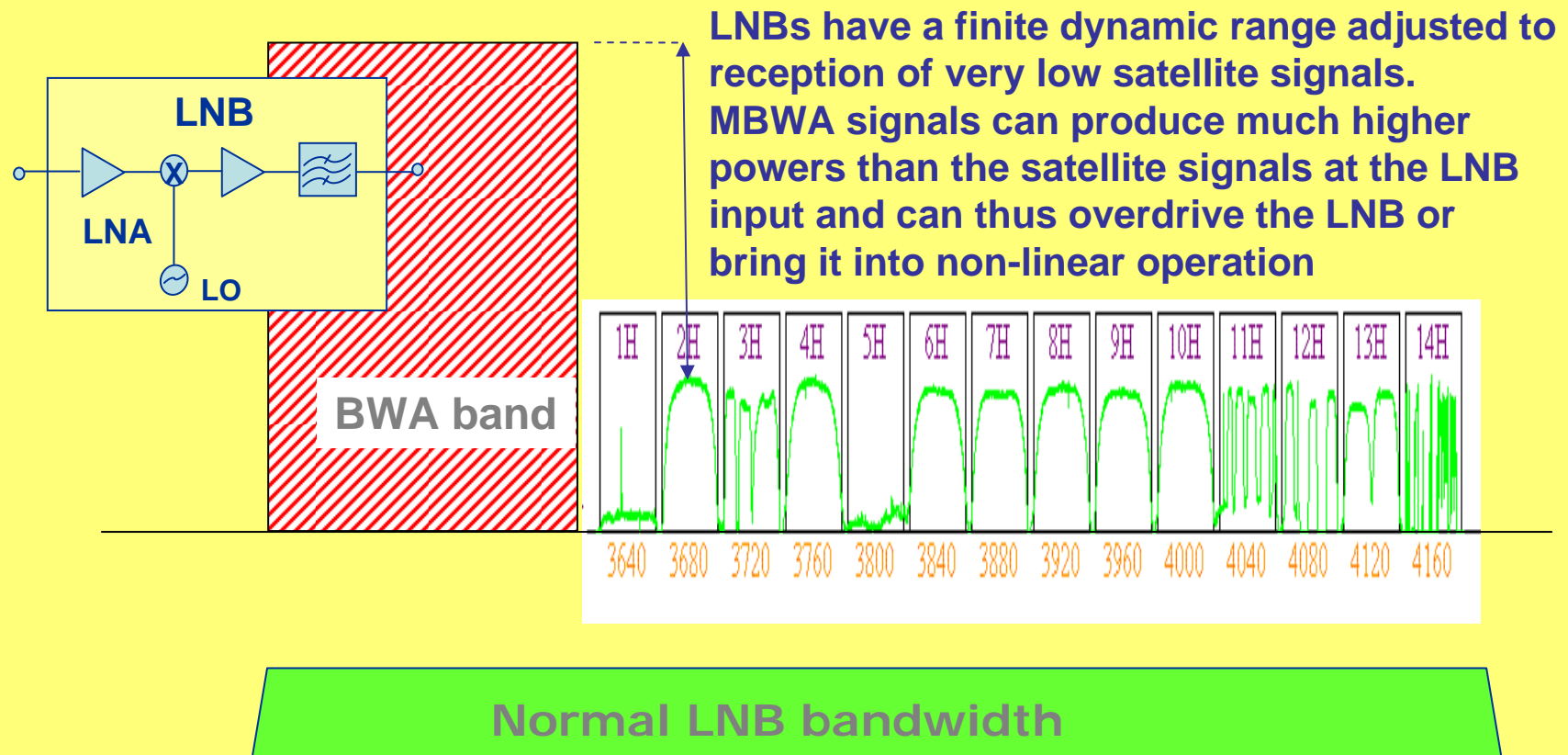
BWA vs FSS

- The sharing situation was extensively studied, in particular in response to agenda item 1.4 of WRC-07 (“IMT”).
- Several compatibility issues were identified:
 - Blockage of reception in same frequency band (“in-band”);
 - Blockage of adjacent frequencies (“out-of-band”);
 - Overload of satellite receiver (“saturation”).
- Main issue = “in-band”

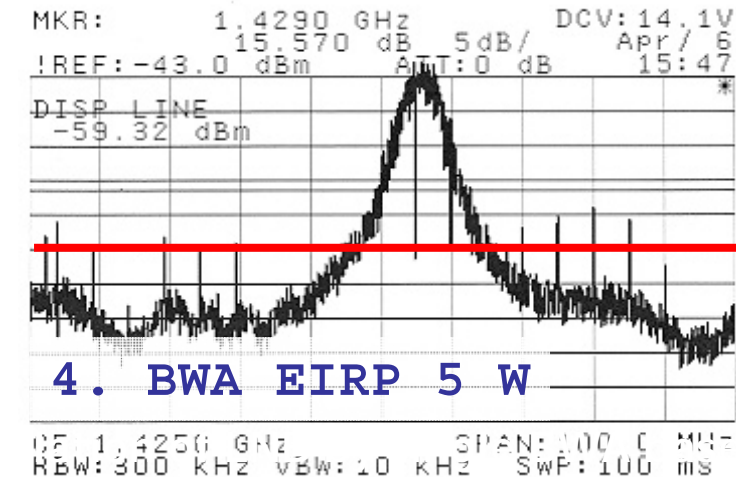
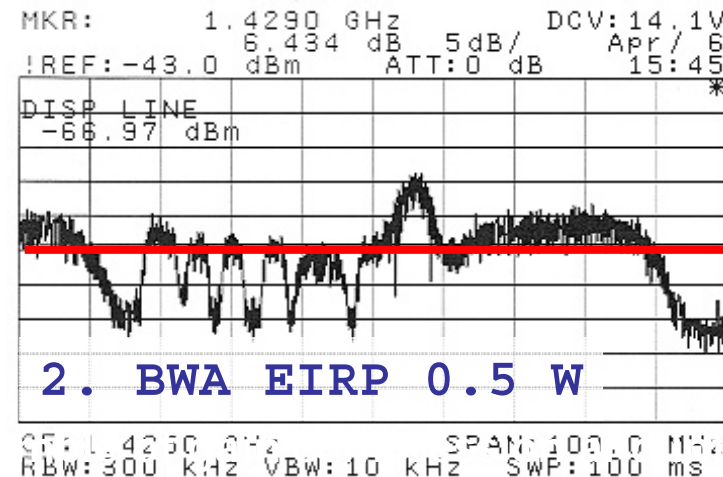
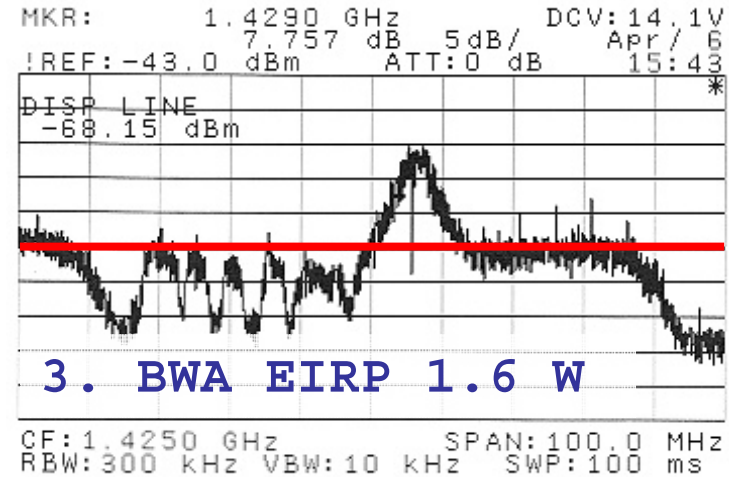
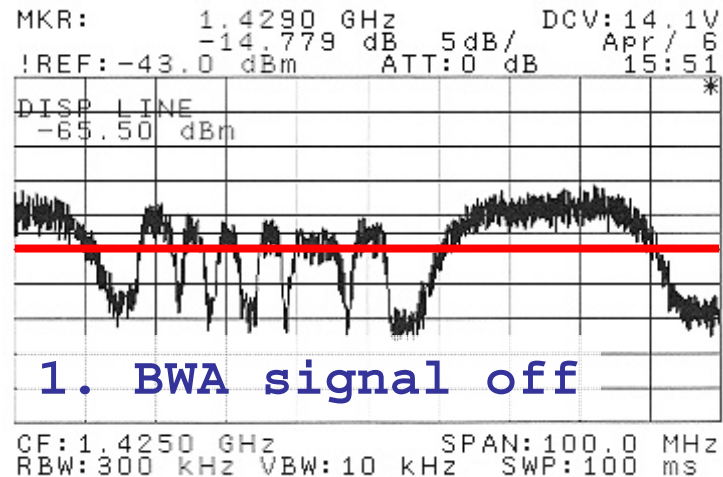
Understanding “Out-of-band”



Understanding “saturation” (1/2)



Understanding “saturation” (2/2)



Solutions identified (1/2)

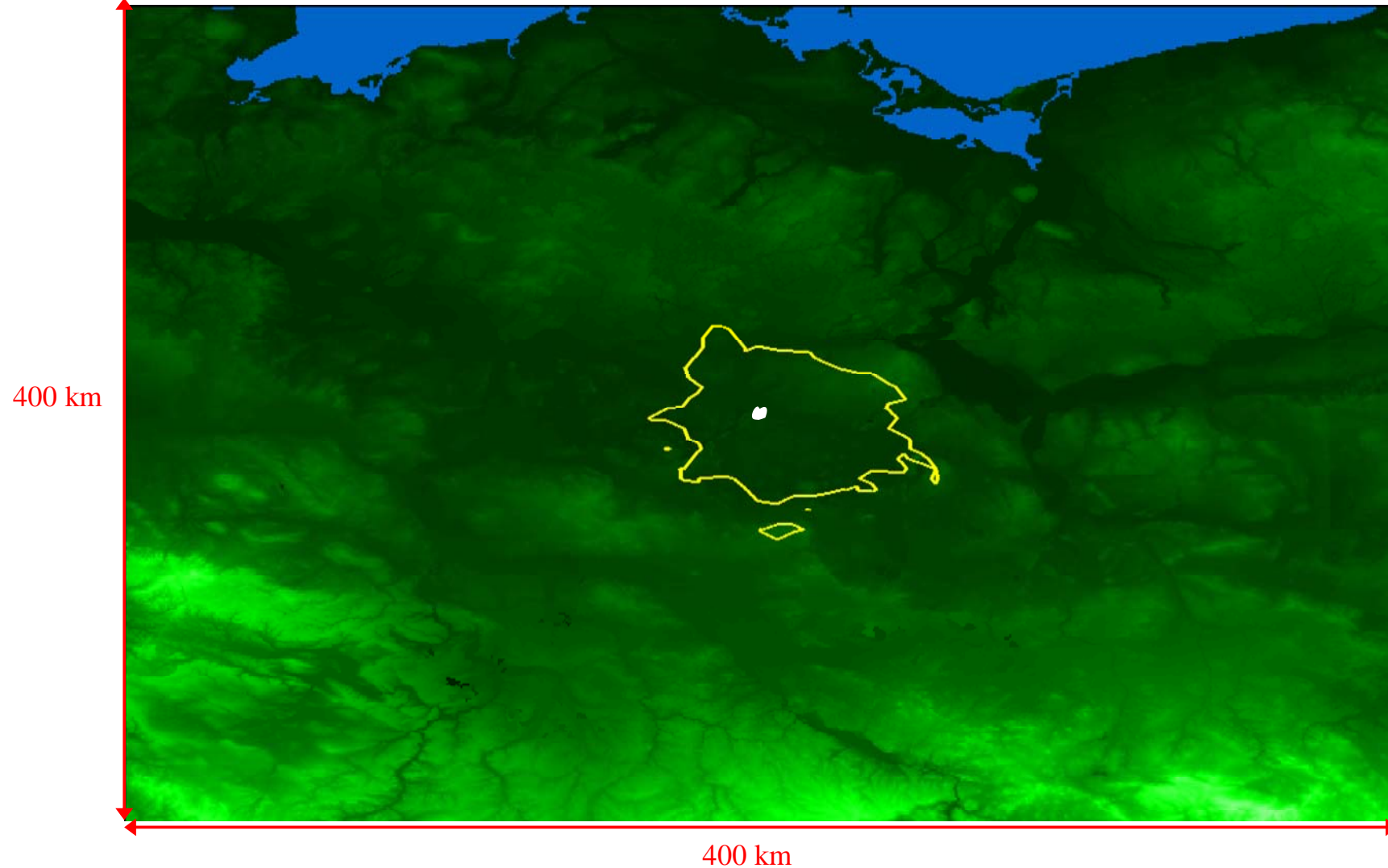
- Separation distances between BWA and FSS receiving earth stations, using criteria defined by ITU.
- Examples of separation distances:
 - “in-band”: several tens of km (up to > 100 km);
 - “out-of-band”: few kilometers (up to 2 km);
 - “saturation”: several hundreds of meters (up to > 1 km).

Solutions identified (2/2)

- Since individual licenses are not usually required for FSS earth stations such as TVRO terminals, which have diverse retail outlets, there is no central record of their locations. Therefore it is not feasible for BWA to share with them in the same geographical area since no minimum separation can be guaranteed.
- Separation distances could be reduced by implementing appropriate mitigation techniques (where applicable), but most of these would not reduce the distances to zero and the others have yet to be shown to be practicable

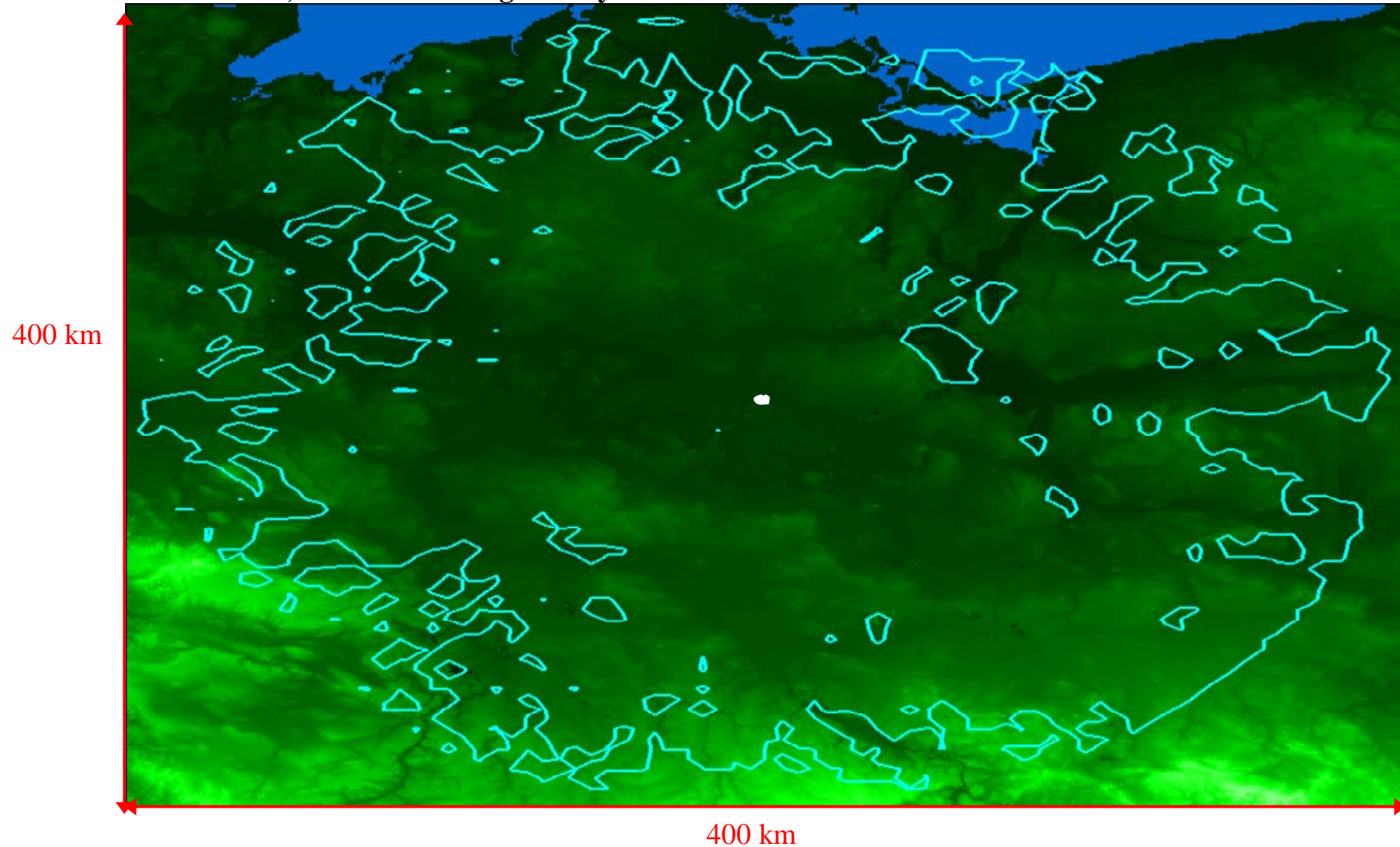
« in-band » separation distance (1/2)

BERLIN earth station; Contour for single-entry I/N to exceed -10 dB for no more than 20% of time

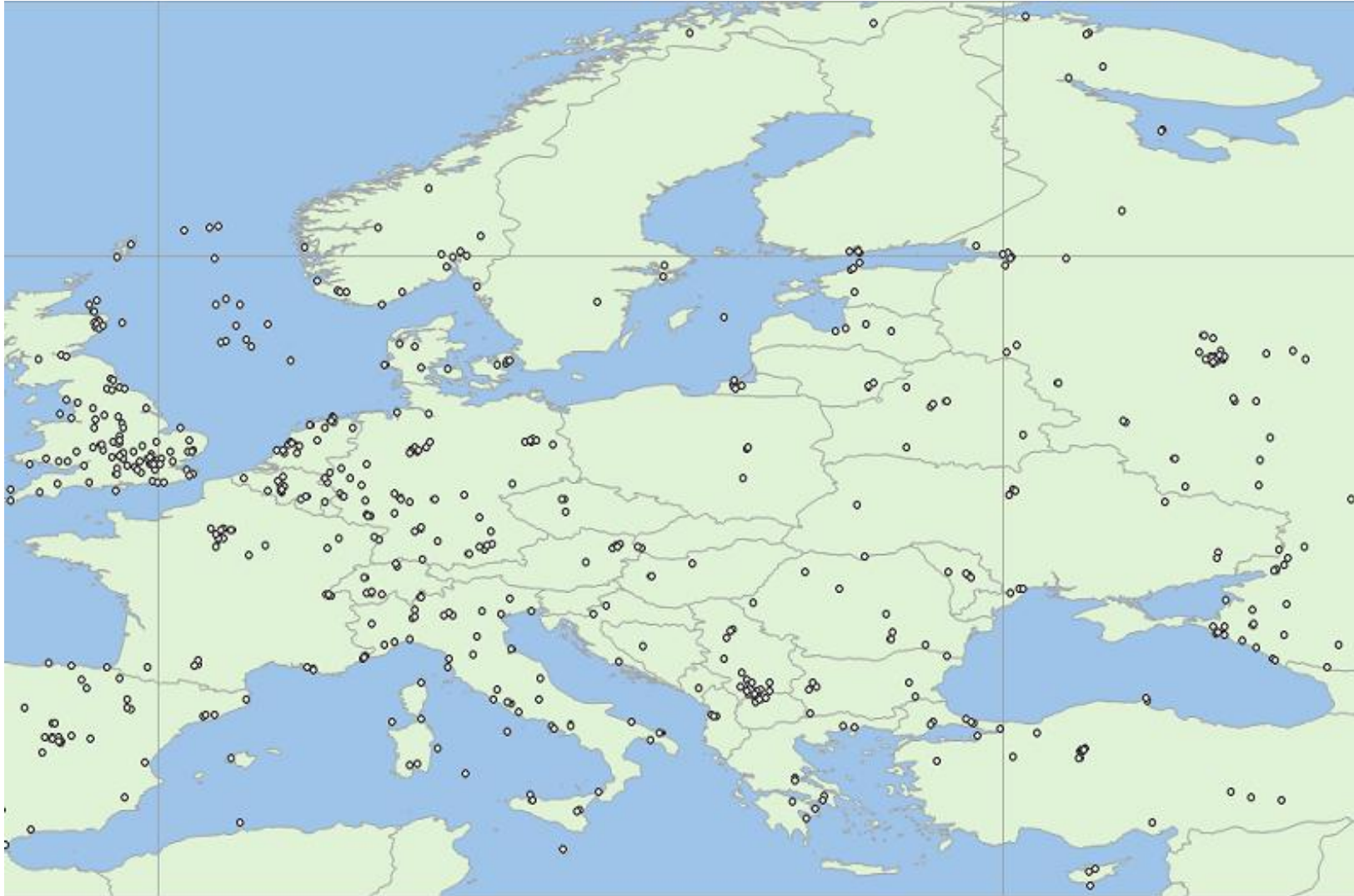


« in-band » separation distance (2/2)

BERLIN e/s ; Contour for single-entry I/N to exceed -1.3 dB for no more than 0.0017% of time



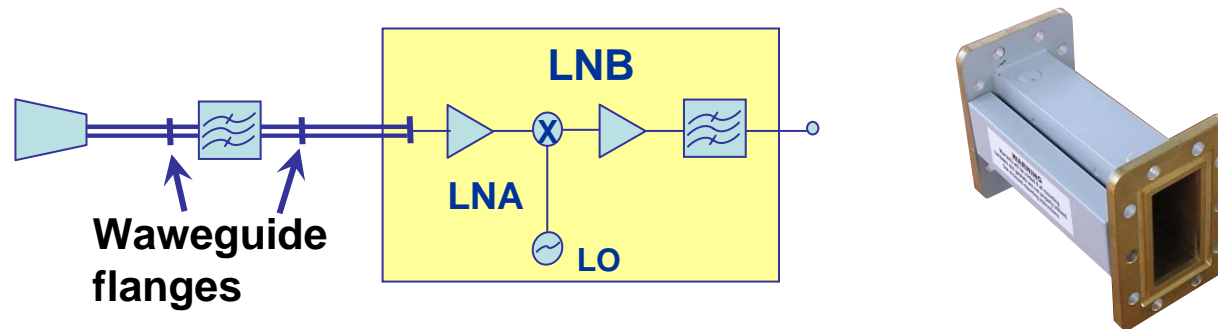
FSS earth stations in Europe



The sites shown are those recorded by Intelsat and SES/New Skies in the band 3400-4200 MHz – (1081 terminals, 694 sites) . Additionally many TVRO earth stations exist but are unrecorded and thus unable to be shown here. Furthermore the map does not show earth stations served in this band by other satellite operators.

Possible mitigation technique

RF waveguide bandpass filter



- Only helps against “saturation” but degrades the radio-link performance (increase of the receiver noise temperature).
- Can not mitigate “in-band”; Can not mitigate “out-of-band”;
- For many antennas, in particular receive only antennas, LNB and antenna feedhorn are molded together in one unit and no filter can be inserted in between.
- Expensive (~ USD 500 - 1000. plus installation fee per earth station-).

WRC-07 outcome (1/2)

- Tough issue solved during the last days of WRC-07
- The outcome
 - No global green light for mobile BWA
 - Limited changes to the Radio Regulations through “opt-in” footnotes to the ITU Radio Regulations that change the permitted use of frequencies by mobile BWA on a country-by-country basis, limited to the band 3 400 – 3 600 MHz.
 - Set of efficient protection measures (regulatory and technical) to protect FSS earth stations in neighbouring countries : Nos 9.17 & 9.18, 9.21 and pfd limit at the border.
 - WRC-07 decided against proposals to open up the band 3.6-3.8 GHz to mobile BWA

WRC-07 outcome (2/2)

Outcome of WRC-07 agenda item 1.4 for 3400-3600 MHz band (no change in 3600-4200 MHz band)



Yellow: Argentina, Brazil, Chile, Costa Rica, Cuba, Dominican Republic, El Salvador, French Guiana, Guatemala, Mexico, Paraguay, Suriname, Uruguay, Venezuela.

3400-3500 MHz :- Primary allocation to Mobile (except aero) Service, subject to agreement under RR 9.21.

3500-3600 MHz :- Existing Primary allocation to Mobile (except aero) Service.

Orange: Albania, Algeria, Andorra, Austria, Azerbaijan, Bahrain, Belgium, Benin, Bosnia, Botswana, Bulgaria, Burkina Faso, Cameroon, Chad, Congo, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, French territories in R1, Gabon, Georgia, Germany, Greece, Guinea, Hungary, Iceland, Ireland, Israel, Italy, Jordan, Kuwait, Latvia, Lesotho, Liechtenstein, Lithuania, Macedonia, Malawi, Malta, Mauritania, Moldova, Monaco, Mongolia, Montenegro, Morocco, Mozambique, Namibia, Netherlands, Niger, Norway, Oman, Poland, Portugal, Qatar, Romania, San Marino, Saudi Arabia, Senegal, Serbia, Sierra Leone, Slovakia, Slovenia, South Africa, Spain, Swaziland, Sweden, Switzerland, Syria, Togo, Tunisia, Turkey, Ukraine, United Kingdom, Vatican, Zambia, Zimbabwe.

3400 – 3600 MHz :- Primary allocation to Mobile (except aero) Service, subject to agreement under RR 9.21, Identification for IMT, IMT to meet pfd limit of -154.5 dBW/(m².4 kHz) at borders with other countries..

Green: Bangladesh, China, French Polynesia, India, Iran, New Zealand, Singapore.

3400-3500 MHz :- Primary allocation to Mobile (except aero) Service, subject to agreement under RR 9.21, identification for IMT.

3500-3600 MHz :- Identification for IMT in existing Primary allocation to Mobile (except aero) Service.

In both bands IMT to meet pfd limit of -154.5 dBW/(m².4 kHz) at borders with other countries.

Brown: Japan, South Korea, Pakistan.

3400-3600 MHz :- Identification for IMT in existing Primary allocation to MS (except aero), IMT to meet pfd limit of -154.5 dBW/(m².4 kHz) at borders with other countries.

Light Green: Rest of World.
3400-3600 MHz ; NOC

Implementing of WRC-07 decisions

- EC
 - Decision for BWA in 3 400 – 3 800 MHz.
 - Parts of this decision violate WRC-07 decisions.
 - Decision recognises the need to protect existing FSS earth stations but does not state how this should be done. Also the Decision does nothing to protect earth stations to be brought on line following adoption.
- Jordan
 - Proposed « freeze » of the grant of VSAT licenses below 3 900 MHz.

Conclusion

- Sharing between BWA and FSS earth stations is not practical in many countries due to large number of existing earth stations, and would in any case lead to:
 - impose constraints on BWA to protect existing earth stations (“holes” in BWA coverage)
 - Prevent further expansion of the use of the band by FSS if and when BWA is licensed in a given area.
- NRAs shall be extremely cautious when deciding to introduce MBWA and shall periodically assess the impact of such decision so as to adapt it if required. They should not depart from international rules.